STUDIES ON SUITABILITY TO INCORPORATE LOCAL WILD FRUITS *FALSA (GREWIA ASIATICA), INDIAN BEAL (AEGLE MARMELOS), SINGHARA (TRAPA NATANS) AND JUNGLE JULIBE (PITHECELLOBIUM DULCE)* IN PREPARATION OF VALUE-ADDED DAIRY PRODUCTS

A Synopsis for the Degree of

DOCTOR OF PHILOSOPHY IN DAIRY SCIENCE

स्वामी रामानंद तीर्थ
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A Synopsis

Studies on Suitability to Incorporate Local Wild Fruits Falsa (Grewia asiatica), Indian Beal (Aegle marmelos), Singhara (Trapa natans) and Jungle Julibe (Pithecellobium dulce) in Preparation of Value-Added Dairy Products.

INTRODUCTION

India is set to become the world's most populated country by 2030 with around 1.53 billion people accounting for 19% of the world population. India currently inhabits approximately 18% of the world population which is growing at the rate of 1.3% annually. The FAO has analyzed global dairy trends as far ahead as 2050. Their analyses predicts that as incomes increase people generally prefer to spend a higher share of their food budget on animal protein-dairy and meat consumption tends to grow faster than that of food crops. Expectedly, the past three decades have seen buoyant growth in the consumption of livestock products, especially in newly industrialized countries and emerging markets.

The graph of the progress of Indian dairy industry has demonstrated an annual production of about 200 MMT in the year 2021-2022, while in Maharashtra annual milk production is about 12 MMT. India is among the world's largest and fastest growing market for milk and milk products. Milk and milk products constitute important nutritional components serve as the source of first class proteins especially for children and vegetarians. It supplies most essential elements like calcium and phosphorus along with numerous other essential major and minor substances. We are set to become the world's most populated country by 2030 with around 1.53 billion people accounting for 19% of the world population. India currently inhabits approximately 18% of the world population which is growing at the rate of 1.3% annually. The FAO has analyzed global dairy trends as far ahead as 2050. Their analyses predicts that as income increase people generally prefer to spend a higher share of their food budget on animal protein-dairy and meat consumption tends to grow faster than that of food crops. Expectedly, the past three decades have seen buoyant growth in the consumption of livestock products, especially in newly industrialized countries and emerging markets.

Wild edible fruits are those fruit species which are not cultivated or domesticated but could be accessible from various natural habitats and used as food. It was estimated

that, humans might have utilized more than 7000 wild edible fruits globally but most of these are remain under-utilized. In many developing countries. Wild edible fruits play a vital role in the livelihoods of Tribal and rural communities residing in forest catchments. These plants serve as an alternative to staple foods during times of seasonal food scarcity and also could be used as valuable supplement for a nutritionally balanced diet. Currently, some Tribal and rural peoples use to sell these fruits in local market, providing a source of income for poor communities. Further, these species could be used as new potential sources for domestication. Currently there is decline in the use of wild edible fruits by the native community people.

Jungle jalebi (*Pithecellobium dulce)* has nutritive and medicinal value, Botinical name Pithecellobium dulce which belongs to the Fabaceae family. These fruits are widely distributed in mostly south India, Australia, South Africa and other parts of Asia.

Singhara or water chestnuts are fruits grown in ponds. Singhara are scientifically known as *Trapa natans,* belonging to the Lythraceae family. Some common names of this fruit are singhara or simkhata in Hindi, karimbolam or vankottakkaya in Malayalam and water chestnuts in English. Singhara is rich in vitamin B6, which is known to reduce stress and uplift your mood. So, when you are more relaxed, your quality of sleep improves, and so does your health! Ladies, a generous quantity of singhara every day keeps the doctor away!

Kheer, also known as payasam, is a sweet dish and a type of wet pudding popular and orginated in the south Indian , usually made by boiling milk, sugar or jaggery, and rice, although rice may be substituted with one of the following: daals, bulgur wheat, millet, tapioca, vermicelli, or sweet corn. The most classic version of this dessert is the rich Rice Kheer, where you slow-cook rice grains, whole milk and sugar to perfection. Addition of saffron, nuts, cardamom, etc. is quite subjective when it comes to this typical Kheer Recipe. The *Jungle jalebi* pods and *Singhara* possess significant amounts of calories, proteins, complex carbohydrates and dietary fibres, for energy requirements, appetite regulation and enhanced digestion of foods in the body.

The nonconventional fruit Falsa (*Grewia asiatica*) has several health benefits for the health of bones, heart, and digestive system. It has demonstrated the blood purifying properties and is very good for treating respiratory inflammation, heart disease, blood pressure, and regulation of heartbeat. The benefits of *Falsa* fruits are attributed to the vitamins and minerals that it contains. It is a delicious fruit having several popular common names like Phalsa, Phalsa berries, Indian Pahlasa, or Falsa. The fruit is easy to consume, and people also like it in juice form. Its health benefits are unique in both fruit

and juice forms. It grows in India, Pakistan, Bangladesh, Nepal, Sri Lanka, Thailand, Cambodia, and Vietnam.

Aegle marmelos, commonly known as, *bael,* also Bengal quince, golden apple, Japanese bitter orange, stone apple or wood apple, is a species of tree native to the Indian subcontinent and Southeast Asia. It is present in India, Pakistan, Bangladesh, Sri Lanka, and Nepal as a naturalized species. The English name for bael is stone apple, as its rather large fruit is like pale yellow to golden orange when ripe. In Sanskrit, it is called bilva or sriphal or shivadruma (the tree of shiva), while in Hindi, it is referred to as bel or bael or sripal (Kritikar and Basu, 1984). Vitamin C levels in unripe bael fruit are relatively high. Furthermore, riboflavin (1.19 mg), vitamin A, thiamine , potassium, calcium niacin and phosphorus are all known to be present in bael fruit. Bael fruit has antimicrobial properties and may help fight against certain bacteria and fungi. Bael fruit has been shown to have anti-diarrheal effects, which may help reduce diarrhoea. Due to acidic property of Falsa and Beal thy can be use in preparation of shrikhand.

National status:

India is the highest milk producer and ranks first position in the world contributing 24% of global milk production in the year 2021-22. The milk production of India has registered 51 % increase during the last eight years i.e., during the year 2014-15 and 2021-22 and increased to 221.06 Mn tonnes in the year 2021-22. The milk production has increased by 5.29% over the previous year 2020-21. India's dairy sector is characterized by "production by masses" more than "mass production", as it provides employment to more than 80 million families in the country[4].The top 5 milk-producing states are: Rajasthan (15.05%), Uttar Pradesh (14.93%), Madhya Pradesh (8.6%), Gujarat (7.56%) and Andhra Pradesh (6.97%). They together contribute 53.11% of total Milk production in the country. India's dairy sector is also a source of pride and self-reliance for the nation, as it has achieved remarkable growth and innovation in the past decades. India's dairy products are not only popular domestically, but also have a potential to expand their presence in the international market.

India is the world's largest producer and consumer of milk and dairy products. The market for dairy products in India has grown rapidly over the last few decades and anticipated to be growing at a faster rate when compared to the global dairy products market. The global dairy product market is expected to witness significant growth over the forecast period. Growing world population base, rise in per capita income, and increase in consumer awareness level

regarding nutritional values of dairy products and, change in consumer dietary patterns are the key drivers regulating the market growth. In addition, technological advancements and innovations for obtaining more milk from dairy animals are also estimated to boost market growth. The market is segmented on the basis of type of product. It includes milk, butter, cheese, ice cream and yoghurt. Among these products, milk, cheese and lactose are estimated to hold major share of the market owing to their rising demand and increased usage rates in all levels of population. Rising consumption levels of foods such as ice creams and milk shakes are also anticipated to drive market growth over the forecast period. Over the next five years, changing lifestyles of urban population and rising demand for healthy and convenient dairy products is anticipated to play an instrumental role in the growth of India dairy products market.

In addition, value-added dairy products have larger shelf life than raw milk. Value-added products help your company become more viable, more visible to the public and open up new markets. Few of the leading players operating in India dairy products market include Gujarat Cooperative Milk Marketing Federation Ltd., National Dairy Development Board, Karnataka Cooperative Milk Producers Federation Ltd., and Tamil Nadu Co-operative Milk Producers' Federation Limited, among others.

As per industry experts, India is contributing about 17 per cent of the total milk production globally. With the projected milk production of 254.5 million tonnes in 2021-22, India will become the largest milk producer in the world. As per Rabobank analysis, in 2016-17 Indian dairy market was largely divided into Liquid Milk (64 per cent), Value Added Products (25 per cent), Ghee (7 per cent) and Milk Powder (4 per cent). Value Added Products in dairy segment is further growing at 15 per cent to 20 per cent year on year that has varied products like cheese, UHT milk, curd, baby Foods, Ice-cream, Butter, Flavored Milk and Dairy Whitener. Value added market in dairy industry is expected to expand to 30 per centof dairy industry by 2020. Indian organised dairy sector is required to strengthen the procurement and processing line to scale up for value added market. On the other side, Industry is looking health aspects very strictly and focus is shifting on nutrition in the milk and value added products which unorganised market is not serving.

Indian consumer is becoming more health conscious and demand for healthier products with natural, organic and an ayurvedic ingredient is increasing. Changing consumer lifestyle, increasing number of working women and increasing personal disposable incomes are leading to an increase in demand of value added dairy products. Smaller packs of packaged dairy products are being aggressively marketed for the second and third tier markets to deepen a

brand's penetration and increase the volume in the country. The increasing numbers of players in the dairy sector are focusing their strategies towards the untapped semi-urban and rural regions, which offer significant opportunities for growth.

International status.

India is the world's largest milk producer and consumer, with a production of 221.06 million tonnes in 2021-22[1], India's dairy sector is dominated by small-scale, marginal farmers, who prefer water buffaloes over cows for their higher fat content and adaptability to Indian climatic conditions[2]. India's milk production accounts for 18.5% of global milk production, but only less than 1% of global trade[3]. India's per capita milk consumption is 427 g/day, which exceeds the world average of 305 g/day[2].India's dairy sector is growing rapidly due to the increasing demand for milk and milk products, driven by population growth, urbanisation, and rising incomes[2]. India's dairy industry offers opportunities for investment in areas such as processing, chilling, logistics, cattle feed, value-added products, organic/farm fresh milk, and exports[1] although this had little impact on the world dairy market as India trades only marginal quantities of milk and dairy products.

Milk is the most valuable protein food that widely consumed by people all over the world. The milk as a raw food is easily available on various dairy farms that are processed to the increases the variety of nutrients. The milk processing include the fluid milk production, cheese production, yogurt production, ice cream production to make the huge variety of milk products like cheese, butter, cream, skimmed milk, yogurt, toned milk or double toned milk and much more. Processing of dairy products gives small-scale dairy producers higher cash incomes than selling raw milk and offers better opportunities to reach regional and urban markets.

The global dairy product market is expected to witness significant growth over the forecast period. Growing world population base, rise in per capita income, and increase in consumer awareness level regarding nutritional values of dairy products and, change in consumer dietary patterns are the key drivers regulating the market growth. In addition, technological advancements and innovations for obtaining more milk from dairy animals are also estimated to boost market growth.

Demand for milk and milk products such as cheese and butter is increasing daily with increase in world population. High-end technology is required to meet these needs by increasing the milk processing capacity and maintaining the quality of the product. The dairy industry is highly localized owing to perishable nature of milk products.

The market is segmented on the basis of type of product. It includes milk, butter, cheese, ice cream and yoghurt. Among these products, milk, cheese and lactose are estimated to hold major share of the market owing to their rising demand and increased usage rates in all levels of population. Rising consumption levels of foods such as ice creams and milk shakes are also anticipated to drive market growth over the forecast period.

Over the next five years, changing lifestyles of urban population and rising demand for healthy and convenient dairy products is anticipated to play an instrumental role in the growth of India dairy products market.

Dairy products are considered an important component of a balanced diet due to their rich calcium content, which is essential for bone health and development. Additionally, dairy is a valuable source of protein, vitamins (such as vitamin D and B12), and minerals (like potassium and magnesium). As consumers become more health-conscious and seek wholesome, nutrient-dense foods, dairy products are witnessing increased demand. Moreover, the growing awareness of lactose intolerance and milk allergies has led to the development of lactose-free and plant-based dairy alternatives, further shaping the market dynamics. Dairy companies are also responding by fortifying products with additional nutrients, catering to the demand for functional foods that support overall well-being.

In 1959, the Food and Agriculture Organization of the United Nations (FAO) produced Milk and Milk Products in Human Nutrition, a seminal treatise on the topic. In response to popular demand, a revised second edition was produced in 1972. Half a century after the first publication, in 2009, it was time to revisit the role of milk and dairy products in human nutrition and development. With rising incomes and increased production, milk and dairy produce have become an important part of the diet in some parts of the world where little or no milk was consumed in the 1970s. Consumption of milk and dairy products is growing fastest in Asia and the Latin America and Caribbean region. India has recently become the world's largest milk producer, yet per capita consumption levels there are still low. Globally, too many poor people are still not able to afford a better diet and greater efforts, including agricultural growth, diversification and public investment, are needed to ensure that poor and undernourished people can acquire food that is adequate in quantity (dietary energy) and in quality (diversity, nutrient content and food safety). FAO, in pursuing its mission of eradicating hunger and improving food security and nutrition for all, seeks to improve awareness among consumers and member governments of the importance of a balanced, healthy and sustainable diet. Our role as a global knowledge centre is to provide sound advice to member countries on the role and value of various foods from production to consumption and their role in human nutrition

and health.

REVIEW OF LITERATURE

The work done by earlier workers have been reviewed and are presented in the following paragraphs.

Khan, et al. (2019) Studied that Phalsa (Grewia asiatica L.) fruit berry is a promising functional food ingredient. This work provides an overview of the bioactive compounds, health benefits, processing challenges, and value addition of phalsa fruit. It also suggests some potential applications of phalsa fruit in dairy products, such as yogurt, ice cream, cheese, and milk beverages

Garg et al. (2021) Reported that their investigation has some merit in highlighting the importance and potential of the wild fruit species in India. The paper claims that the species Bael (Aegle marmelos Correa), an important fruit of Indian subtropics, traditionally utilized in the preparation of preserves, candy, squash, RTS, etc., has immense therapeutic potential. An attempt was made to develop a bael-based alcoholic sweet fermented beverage (may be called bael cider), that has high nutritional, medicinal, and economic value, and that can contribute to food security, livelihood enhancement, and biodiversity conservation.

Nawaz, et al., (2020). Studied that they planned to develop cream cheese using frozen and dehydrated (F & D) phalsa. The developed product quality and acceptability were subjected to sensory evaluation, followed by various analyses to check the microbial activity of frozen & dehydrated phalsa-based products. The microbial count was 18 cfu/mL in frozen phalsa-based products and 14 cfu/mL in dehydrated phalsa-based cream cheese. it is concluded based on results that dehydrated phalsa-based products proved to be most effective as compared to frozen phalsa-based products. They worked on further research, such as optimizing the formulation and shelf life of the products. fruit can be used to enhance the nutritional and sensory value of cream cheese, which is a popular dairy product. This work also provides information on the processing methods and storage conditions of the phalsa-based products, which can be useful for dairy product developers.

Meshram, et al., (2019), Studied that their study provided a new perspective on how to utilize singhara flour as an ingredient for enhancing the sensory quality and nutritional value of peda. They also demonstrate the potential of singhara flour peda as a marketable product that can appeal to both domestic and international consumers. This product can be a

novel and value-added dairy product that can cater to consumer demand for health and taste. The paper also states that the addition of singhara flour reduced the fat, protein, and ash content of peda while increasing the total solids content. The authors used four levels of singhara flour (0%, 5%, 10%, and 15%) with 30% sugar and mixed them with khoa, which is a heat-desiccated milk product, to prepared.

Kaur, et al., (2019) Reported that studies on the effect of bael pulp and stevia on the sensory, nutritional, and microbiological quality of dairy products. The authors state that bael and stevia are underutilized plants with medicinal and nutritional benefits, but there is no information on their use in dairy products. They also mention that there is a need to develop low-calorie and sugar-free dairy products for health-conscious consumers. Therefore, they aim to evaluate the sensory, nutritional, and microbiological quality of gajrela and burfi prepared with bael pulp and stevia.

Kachhawa et al., (2023), Reported that studies and gives a brief background on the importance and benefits of jungle jalebi fruits, as well as the rationale for studying their physical-functional properties, describes the procedures for preparing the fruit powder and measuring its properties in detail; and is informative and comprehensive, as it covers a wide range of physical-functional properties that are relevant for food processing and formulation. They contributed knowledge on the utilization of minor fruit plants as functional foods and provided useful information for researchers and food technologists who are interested in developing innovative food products using jungle jalebi fruits.

Anadani, et al., (2023) Studied that developed a novel value-added product from Bael fruit powder, which is a natural and underutilized plant with many health benefits. It also suggests that bael fruit powder can enhance the nutritional value of cookies by increasing the fiber, protein, ash, and calcium content

Objectives:

- To evaluate the suitability of incorporating *Phalsa and Beal* fruit pulp to optimise the formulation in preparation of *Shrikhand*,
- To evaluate the suitability of incorporating Jungle Jelibi and Shingara fruit powder to optimise the formulation in preparation of *kheer*,
- To study the impact of fortifying these traditional dairy products with the pulp or powder of nonconventional (wild varieties of fruits) fruits on the sensory qualities of the innovative products.

- To study the nutrient content, antioxidant activity, and probiotic properties of the value added dairy products

MATERIALS AND METHODS

1). **Sample collection:** Samples of the ripe fruits of selected two varieties will be collected from the local market. The pulp/powder of the respective fruits will be analyzed for its compositional parameters.

2). **Procurement of raw materials and ingredients:** The raw materials like milk and other consumables *viz.* sugar, flavour, rice, edible colour, condiments and eventual will be procured from the local market in bulk quantities,

3). **Standardization of methodology for preparation of value-added products:** The methodology for preparation of the proposed products, viz. *Phalsa and beal* fruits pulp-fortified *Shrikhand* and *Jungle jelibi and Shingara* powder-fortified *Kheer* shall be standardized by admixing various levels of the fruit pulp/powder to get the innovative products with desired sensory characteristics,

4). **Sensory evaluation of the proposed value-added products:** The proposed new products will be subjected for its sensory evaluation through a panel of judges by employing the nine-point Hedonic scale.

5). **Storage studies of the value-added products:** The storage studies of the proposed new products will be conducted at various temperatures for specific time intervals.

6**). Economic feasibility of the value-added products:** The economic feasibility studies will be conducted to compare the traditional products with its value-added counter parts so as to get the cost analyses of both of the products under investigation.

7). **Statistical analysis:** The data generated will be subjected to statistical analysis by employing suitable statistical models/designs.

WORK PLAN

Sr.No.	Activity(s)	Estimated period
1	Survey of published literature from Library and Digital sources.	Six months
2	Selection and processing of targeted fruits of targeted varieties and their further processing.	Six months
3	Standardisation of method preparation selected two dairy products, i.e., *Shrikhand* and *Kheer,* by incorporating the pulp and powder preparations.	Six months
4	Sensory evaluation and Nutrient proximate analysis studies of the value added dairy products with nonconventional fruit ingredients and their storage studies.	Six months
5	Economic feasibility and cost-benefit analysis.	One month
6	Statistical analysis of the data.	One month
7	Preparation of final synopsis of the research work done and final Result seminar.	One month
8	Thesis writing and submission of the thesis to the university.	Three month

IMPORTANCE OF THE PROPOSED STUDY

Nonconventional fruits are considered nature's gift to human beings as they can prevent and cure many illnesses. The wide variety of functional components, which can demonstrate an array of biological functionalities. In the recent past, research regarding the functionality of unutilized or unconventional plant components and their use in food products has attracted the interest of the scientific community. Traditional dairy products are popular throughout the country and are well liked by all age groups. Considering the present consumption trends of traditional dairy products and some of their ill effects on health, the proposed study will open new vistas in value addition as both of the proposed products are well suited for this type of incorporation. The proposed study will elucidate the suitability of incorporating the health-promoting benefits of dairy products by way of value addition.

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